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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/901,526	07/09/2001	Matthias Forster	INF-1078	7099

7590

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EXAMINER

MULPURI, SAVITRI

ART UNIT PAPER NUMBER

2812

DATE MAILED: 03/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/901,526

Applicant(s)

FORSTER ET AL.

Examiner

Savitri Mulpuri

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 17 December 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 12-23 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 12-23 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☐ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 12-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Thakur et al (6,187,628) in combination with Lin et al (US 6127,221) or Yew et al (5,753,359).

Thakur et al discloses a method of growing silicon layer with micro-roughness of hemispherical growth by the following process steps: Providing a substrate "12" in a chemical vapor deposition process chamber, growing polysilicon layer "16" over the substrate; growing thin oxide layer "18"; generating process gas containing semiconductor material to grow a rough polysilicon layer "20" in in-situ chemical vapor disposition. Thakur teaches without annealing the rough silicon layer "20", growing dielectric layer "20". Thakur et al grows silicon layer in single growth step exactly similar to what is claimed in instant process. Thakur et al discloses providing silane gas at growth temperature 500-700 C and pressure in the range of 70 mTorr to 50 Torr, which includes claimed range (100mTorr to 600mtorr) to produce rough polysilicon with the thickness in the range of 300 angstroms to 1000 angstroms (see fig.1 and col.3, lines 23-47). Thakur et al further discloses pre-cleaning the substrate in HF prior to growth to

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inherently provide oxide free surface because HF etches natural oxide deposited on silicon substrate surface (see col.2, lines 7-8). Thakur et al discloses the whole process is applied to form either trench or stacked capacitor for DRAMs (see col.1, lines 24-27). Thakur et al teaches a method of making rough polysilicon in single growth step without annealing step at similar growth conditions as growth conditions recited in instant claimed invention. However, Thakur et al do not teach hydrogen/silane or nitrogen/silane ratio to grow rough polysilicon.

Line et al teach silane concentration  $10E-3 /m^3$  in nitrogen ambient, which imply the nitrogen content is more compared with silane (see fig. 5 for spacious hemispherical grains and col.5, lines 1-18). Yew et al discloses ratio of hydrogen to silane is 98 percent (see abstract and col. 7, lines 40-56). It would have been obvious to one of ordinary skill in the art to use heavy dilution of silane or hydrogen for hemispherical growth because Lin or Yew teaches the suitability of nitrogen to silane or hydrogen diluted silane for hemispherical growth. Since roughness is directly proportional to silane dilution, selecting the ratio of hydrogen or nitrogen to silane would have been well within the scope of one ordinary skill in the art depending on the required degree of roughness of the polysilicon for DRAMs. Conclusively, modified invention of Thakur et al, as modified by the teaching Lin et al or yew et al, would have polysilicon grains with spacing in-between and not a continuous layer (refer Lee fig.5) which give more surface area and in turn capacitor with high capacitance fro DRAMs.

***Response to Amendment***

Applicant argues that Thakur et al teaches no HF is required. HF cleaning is not required once the wafer is placed in the chamber because growth is in-situ growth. Thakur et al teaches HF cleaning (see col.2, lines 7-8). Applicant argues that process conditions in Thakur et al is different from the process conditions in instant invention with respect to pressure, time and dilution. However, pressure and temperature range in Thakur et al is included in claimed pressure and temperature range. Modified invention of Thakur, as modified by the teaching of Lin et al or Yew et al teaching dilution of silane with hydrogen or nitrogen to grow hemispherical growth, would have spherical grains with spacing in-between and not a continuous layer as is shown by Lee et al. Applicant points out the criticality of temperature, time and dilution in the instant invention. However, in view of temperature and pressure in Thakur et al as modified teaching of Lin et al or Yew et al for dilution of silane would have hemispherical growth in the invention of Thakur et al and would have grains having space in-between and not continuous layer. Conclusively, Temperature, pressure, dilution in modified reference of Thakur et al are met by claimed conditions, Thakur would hemispherical grains with no space in-between. If the space between grains is more i.e more roughness, which gives more area and more capacitance.

***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.**

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See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Savitri Mulpuri whose telephone number is 571-272-1677. The examiner can normally be reached on Mon-Fri from 8 to 4.30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling, can be reached on 571-272-1679. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through

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Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Savitri Mulpuri  
Primary Examiner  
Art Unit 2812